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ABSTRACT

Science teachers need to be teachers of reading since the act of being able to read and comprehend is necessary in problem solving. There should be a variety of learning opportunities in ongoing lessons and units of study, and reading subject matter is one important facet of achieving. This paper offers several learning strategies that student teachers and cooperative teachers used for helping students comprehend science subject matter more thoroughly. (CCM)

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Reading Comprehension in the Science Curriculum

by Marlow Ediger

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READING COMPREHENSION IN THE SCIENCE CURRICULUM

Science teachers need to be teachers of reading since the act of being able to read and comprehend is necessary in problem solving activities. There should be a variety of learning opportunities in ongoing lessons and units of study, and reading subject matter is one important facet of achieving. It certainly is true that some classrooms stress reading of content to the point that other kinds of experiences are almost nonexistent. Reading is one approach in learning in science.

What might the teacher do to assist pupils to comprehend science subject matter more thoroughly in reading? There is always the problem of new words that pupils cannot identify in reading science content. How should these situations be handled? I will offer several suggestions that my student teachers and cooperating teachers whom I supervised in the public schools used.

1. A good reader pronounces words that are unknown to pupils as they read silently. As a first grader during the 1934-35 school year, and later elementary school years also, I was asked by the classroom teacher to pronounce unknown words to pupils when they raised their hands during silent reading. This approach can be overdone if the same pupil is asked sequentially to pronounce unknown words to others. Pupils individually would also like to pursue their own reading interests. Sometimes, a pupil pronounces an unknown word too quickly to a learner, not permitting adequate time for the latter to ascertain what the unknown words is. If a pupil does not know what the unknown is, he/she should have enough time to determine what the correct word is. The opposite situation occurs also whereby a pupil has to wait too long to obtain help with identification of unknown words when reading science content.

2. The teacher should write new words on the chalkboard in neat manuscript letters prior to pupils reading a selection in science. He/she needs to go over each printed word several times with pupils in class.

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The teacher needs to be certain that pupils are looking at each word as it is being pronounced by the teacher or individual pupils. Using this approach assists pupils to see the new words on the chalkboard in print before seeing them while reading. Hopefully learners will recognize each word as it is being read in science.

The printed words may be written individually or within a sentence on the chalkboard. I prefer the latter approach since it is more contextual. Pupils may learn to use context clues more thoroughly when seeing new words printed within sentences. Learners need to attach meaning to these new words. Context clues many times provide the needed information for pupils to understand needed meanings. Sometimes, a word needs to be defined so that pupils know intended meanings and can read content more proficiently.

3. cassette recordings may be made of science content pupils are to read, be it from the basal or from a library book. The teacher need not always make these recordings, if his/her schedule is very busy. I have observed good readers make excellent cassette recordings of science subject mater. The same content may be listened to by a reader as he/she reads sequential ideas from a book. If the reader does not identify selected words in context, the recorded voice will provide the necessary information. This approach can be used very successfully when pupils read in science. Carlo (1996) wrote:

For many young children and poor readers, there's a substantial time lag between when they see and hear a word. That lag produces slow, laborious reading that makes comprehension all but impossible. It's terribly difficult for students to recall what a passage is about when they have to spend so much time figuring out each new word.

A recorded book can, in effect, do what the child is not yet able to do naturally. It verbalizes the printed words with the correct pace, phrasing, and expression. As a result students make fewer reading errors, and the possibility of forming incorrect reading patterns is diminished.

Best of all, it's not necessary to recall dull, simple reading materials to develop a student's sight vocabulary.

4. instead of reading from the basal text, pupils may read subject matter from library books related to the ongoing lesson or unit of study.

There needs to be an adequate number of library books so that a learner may choose a book that is on his/her reading level. I observed several lessons in a public school where this procedure worked very successfully. Pupils would then share with the entire class that which had been read. Ediger (1996) wrote:

> One approach in emphasizing sequence is to have students choose the order of experience within a flexible environment. Thus, for example, in individualized reading, a learner selects which library books to read sequentially. After reading a book, the pupil has a conference with the teacher to appraise progress. After the completion of the conference with the teacher, the learner is ready to select the next library book to read. The teacher intervenes in library book selection if the student is unable to choose and complete reading a book.

In situations involving individualized reading in science, the pupil orders his/her own experiences. Sequence, it is felt, resides within the involved learner. Others, the teacher included, cannot select the order of goals for a learner to attain. The student in individualized reading must do the processing of content. A teacher determined science reading curriculum does not work, according to advocates of individualized reading. Humanism, as a psychology of learning, strongly advocates concepts such as the following:

1. student-teacher planning of the science curriculum.
2. learners choosing from diverse objectives which to achieve and which to omit.
3. learning centers from which pupils may select their learning opportunities.
4. students being involved in determining objectives within a contract system. In contract form, the pupil with teacher guidance plans which experiences to complete along with the date of completion. Both pupil and teacher sign the contractual agreement in science.
5. a good reader might read the selection for the day from the basal science text orally to slower learners in reading. The latter may follow along in their own textbooks as the words are read orally. These participants may be seated close together in an atmosphere of respect

so that optimal listening is involved. The good reader should explain difficult concepts to pupils as they are being met in print. After hearing the science content read orally, I have noticed slow readers who desire to read the entire selection to themselves.

6. peer teaching can be quite effective in reading science content. With peer teaching, two or three pupils read the contents orally from the basal text; each follows along in his/her book as the other reads. If a slow reader does not wish to read orally, the other two pupils may do the oral reading. These learners may also discuss salient ideas from the science content read. The goal in all of these reading endeavors is to assist pupils to comprehend and understand science content, not to ridicule or minimize. Respect for others is always salient in each science lesson and unit of study.

7. I have observed where no basal texts are used in science and pupils read content from library books directly related to the unit being taught in the science curriculum Pupils then have done an outstanding job of telling what was read as it relates to the ongoing discussion in thematic unit teaching. Pupils individually tend to select library books that are on their reading level to comprehend well. I believe many pupils feel more at ease reading from library books as compared to the basal. Canney and Neuenfeldt (1993) wrote:

Most elementary teachers still use a basal for reading instruction. However, it appears that teachers combine children's books and basals, which is a change from previous reports. Teachers perceive themselves to be in line with school district policy to support their preference for a basal/tradebooks combination. Most teachers also say that they have access to an adequate supply of tradebooks and 85 % believe that children should read independently for 15 to 30 minutes daily. Finally, regardless of teaching experience, formal training in reading, or grade level taught, most teachers prefer a combination of basal and tradebooks in their reading programs.

8. I have also successfully observed whereby two volunteers from the community assisted selected learners who had difficulty identifying words in reading from the science textbook. The volunteers listened carefully to pupils read orally in a designated area. They helped pupils

with recognizing unknown words and pronouncing selected words to these learners as was needed. Seemingly, these same pupils were then ready to read the same science selection on their own. They were also able to enter the discussions effectively in the classroom pertaining to what had been read.

9. there are teachers who have simplified content contained in the text. By using less complex words and shorter sentences, selected pupils might now read and understand the revised subject matter. Generally, teachers have confided in me that the approach is good but the work involved in rewriting takes up an excessive amount of time.

10. sometimes, slow readers have read well from the basal after having listened to the class discussion covering the related subject matter. By listening carefully to the discussion, slow readers may be able to read the same content from the basal science textbook due to possessing readiness information for reading. I am not entirely in agreement with this procedure; however, the teacher needs to assist pupils with a variety of procedures in word recognition and comprehension so that each pupil may attain more optimally in the science curriculum. McNinch and Gruber (1996) wrote:

> What children ultimately learn about literacy is heavily influenced by the expectations, skills, and concerns that parents, teachers, and principals share. All players in literacy development should possibly share common perceptions, especially in the basic philosophical and pedagogical beliefs. if children are to receive coordinated instruction. Do parents, teachers, and principals agree on the basic reading issue of whole language versus traditional skill development?...
>
> Parents, teachers, and principals each perceived that the development of literacy in young children is developed broadly both through traditional practices and whole language, emerging literacy routines. The research groups find favor with traditional readiness activities...Also, they perceive that children learn literacy as an emerging activity through such activities as repetitive listening, shared story telling, invented spelling, and creative writing.
>
> Emerging literacy is a mutual product of the home and school environment acting together with common interests. It does appear that the literacy providers, parents and teachers, are supporting each other in an eclectic approach to learning.

How Much Assistance Should be Given In Word Recognition Techniques?

There is no easy answer to this question. So often, it is felt and believed that the teacher of reading alone should assist pupils in word recognition and identification. A problem then results with pupils who need much guidance to identify unknown words in reading in the content fields, such as in science. Certainly, pupil achievement, in part, will be due to how well a learner reads and comprehends subject matter to solve problems. Thus, it behooves the teacher to assist pupils in reading science materials. The more that reading is stressed as a means of learning the more likely it will be that pupils need assistance in word recognition.

There are six word recognition skills that pupils need to develop skill in. The use of picture clues to unlock unknown words will be used more so on the early primary grade levels as compared to later times. Why? There are more pictures in a basal science text on the early primary grade levels as compared to later times. If a first grader, for example, does not know a word, he/she may look at a picture on the same page and the unknown word will usually become known. There are exceptions here so the primary grade pupil, as well as at later sequential stages of learning, will need to learn additional procedures, other than using picture clues, to unlock unknown words.

Phonics is taught more than any other technique to unlock unknown words. There are degrees of regularity in using phonics to recognize words. Thus there are many sound/symbol relationships that are consistent in the English language. The words - ban, can, Dan, fan, man, Nan, pan, ran, tan- follow a consistent spelling between each grapheme and phoneme. Sometimes, only a few letters in a word will have consistent spelling between symbol and sound, such as the following words-- globe, scale, miles, and agriculture. Selected words are spelled very irrationally, such as through, bough, cough, bought,

and dough. Thus, there are words or word parts that need to be learned through the sight method, not phonics. Learning words through the sight method makes it so that the learner has no approach to use to unlock unknown words in science.

The use of context clues is a very valuable procedure to use to unlock an unknown word in science. Thus if a pupil does not know how to pronounce a word, he/she looks careful at the surrounding words and may be able to identify a word that fits in and makes sense. Sometimes, there are not enough clues in the surrounding words to assist in determining what the unknown word is, such as "I see a ..... There are too many words that make sense contextually. But if the reader uses phonics also, perhaps the unknown can be identified, such as "I see a l....." Here, the "l" letter is very consistent in sound and the pupil may now be able to determine what fits in.

The use of syllabication skills may prove very helpful to the reader to unlock unknown words in science. A word that appears to be new and unknown may not be so if the pupil divides the "unknown" into syllables. for example, the word 'unimportant" looks long until the pupil notices the prefix "un." If the pupil knows the prefix "un" means "not," then it should be very possible to identify and attach meaning to an unknown word. Many prefixes and suffixes appear again and again in reading and the pupil soon becomes skillful in dividing a science word into syllables to identify and pronounce it correctly.

I recommend that teachers of science be teachers of reading and assist pupils to learn approaches in word recognition which make for independent readers. Science lessons and units do emphasize reading as a means of acquiring information; therefore, pupils need to comprehend subject matter through reading.

Diverse Purposes in Reading

There are many purposes for reading in science and not one purpose or reason only. Comprehension of science content is an overall goal. Certainly, pupils should read for meaning and not for the sake of

going through the motions only. The concept of "comprehension" needs to be broken down to more specific aims in the reading of science content. I believe that reading to solve problems in science should be the major goal. Most science educators put high priority in having pupils read to solve problems. Certainly, life in society demands that we identify and solve vital problem areas. There is much confusion as to what can be termed as a problem. Should these come from pupils only with teacher assistance? Might teachers select problems which pupils accept once readiness for learning has been developed? I have observed in classrooms where pupils do accept problems identified by teachers if there are stimulating ways of doing this. With stimulating audiovisual aids presented meaningfully to capture learner interest, pupils might well accept teacher identified problems in science for solving.

In addition to reading to solve science problems, pupils should read critically. Here pupils analyze subject matter read. When analyzing, learners separate component parts so that each facet may be assessed thoroughly or at the developmental level of the learner. I have observed pupils debate the accuracy of selected statements after analyzing. Reference books and other sources are looked at to check accuracy. There are many slogans that abound in society and these may be found in content being viewed carefully by pupils. Are slogans, for example, like the following true?

1. That government is best which governs least. Is there a chance that so little government makes for anarchy?
2. It's not guns that kill, but people kill.
3. Let's get government off our backs and our of our pockets.
4. Let's not throw money at problems.
5. Long prison sentences deter crime.

Each slogan should be evaluated in terms of being based on evidence or are they myths? Sometimes, the bandwagon approach is in evidence in society in that everyone joins the majority in whatever is

being stressed. I believe we are very guilty of this in education. For example, in the early 1970s, performance contracting came in big into American education. Thus the business world entered the educational arena by contracting for providing educational services to public schools. They promised larger gains in pupil achievement than what traditional approaches could produce. For every pupil that achieved, according to what was in the business contract, the company would receive that amount as specified in the agreement. There were many schools wanting to join in on performance contracting since "pupils would achieve at a higher level." This plan soon fizzled out in that pupils did poorer as compared to using traditional approaches in teaching, Second, many teachers taught directly to the test in performance contracting which other schools could not do. Teaching directly to the test items should make for higher achievement if test results are used to determine pupil progress. Performance contracting has reappeared but under much less publicity and fanfare, such as in Educational Alternatives, based in Minneapolis, Minnesota. The band wagon approach needs to be analyzed in critical thinking situations. "The everybody is doing it" philosophy can be very harmful to individuals and groups in society, as well as in the science curriculum.

Pertaining to critical reading, Harris and Sipay (1985) wrote:

An important kind of critical reading involves comparison of two or more sources of information. Children are usually amazed when they first find two authorities contradicting each other. An experience like that can serve as a preliminary to discussion of such questions as the reputation and prestige of each author, his impartiality, or bias, the comparative recency of the two sources, and so on. Reading experiences of this sort develop naturally when children do wide reading to find data on a problem. The teacher should be alert and should make use of such occasions as steppingstones toward a more mature attitude on the credibility of reading matter. In the study of current events, comparison of the treatment of an event by two newspapers or magazines of opposing points of view can form an effective point of departure.

A second kind of critical reading involves considering new ideas or information in the light of of one's previous knowledge and beliefs. The thoughtful reader asks... Is it reasonable. Is it possible? He does not , of course, automatically reject the unfamiliar idea or challenging

conclusion.. But ...becomes doubly alert when he finds disagreements with what he has previously accepted as true.

Creative thinking is another relevant goal for pupils to achieve in reading science content. Learners need to be able to brainstorm and come up with unique, novel ideas in ongoing lessons and units of study. In the area of reading science content, pupils, for example, might have heard the following:

1. the planet Saturn has a solid core or ring around itself.
2. there is no relationship between dinosaurs and birds on the evolutionary scale.
3. amphibians are not becoming fewer in number on the planet earth.
4. all dinosaurs were cold blooded animals.

The teacher needs to stimulate pupils to raise innovative questions as well as come up with unique responses to statements made by others or read from older reference sources. Thus pupils may come up with updated information pertaining to the above four statements. There are numerous ways that pupils can come up with creative answers to problem areas:

1. Have a committee read from a variety of recent reference sources and give a report to the class on ringlets that encircle the planet Saturn. Illustrations may be shown as the oral report is given. A model solar system might also assist pupils to understand contents in the report.
2. assist a committee to discuss and summarize contents on recent discoveries in Patagonia, Argentina pertaining to a possible linkage between dinosaurs and birds in prehistoric times. A map should be used/drawn showing the region of these findings.

In addition to giving science reports, pupils may also show what has been learned through

1. the making of dioramas, models, movie sets, and flannel boards with cutouts.

2. dramatic activities including formal, creative, pantomime, and role playing.

3. outlining, summarizing, concluding, and paraphrasing.

4. developing parts for and presenting a reader's theater presentation.

5. doing a collage, a bulletin board display, and an outside the classroom series of displays, placed on corridor walls.

6. engaging in discussions, debates, committee work, individual study plans, use of learning centers for enrichment, reading library books, and pupil/teacher planning of learning opportunities.

7. performing science experiments and demonstrations. This is the heart of the science curriculum.

In addition to problem solving, as well as creative and critical thinking in reading science content, pupils should also practice reading for causes and effects such as in the causes for natural disasters. Events read should be evaluated in terms of causes for happenings. This is a precise aim of reading instruction in the science curriculum. Pupils then should use methods of acquiring and appraising information in the same way as does the professional scientist

An additional skill in reading science content is reading for factual information. Sometimes, it seems, according to many educators, that factual acquisition is not necessary. But, this should not be the case. Facts provide the building blocks for pupils to use in developing concepts and generalizations. A relationship of facts, perceived accurately by the learner, should make for quality generalizations. Within a concept, there also are many facts. Look at the following generalization that might well be important for pupils to achieve in a unit on Rocks and Minerals:

1. there are igneous, sedimentary and metamorphic rocks. There are four concepts here-- igneous, sedimentary, metamorphic, and rocks.

Inside of each concept, there are numerous facts. Thus the

concept-- igneous-- refers to molten materials such as lava or magma that comes from the interior of the planet earth

Reading for facts then is important to develop concepts and generalizations. Should facts be read for their own sake? I do much reading of subject matter and find factual reading for its own sake can be quite interesting and enjoyable. For example, I have found very little practical use for knowing facts pertaining the thinking of Aristotle in ancient Athens whereby he believed the brain to be the place of cooling of the human blood. I have noticed that many others do not find Aristotle interesting to read pertaining to his beliefs on physiology and the natural environment. Thus my undergraduate students, in most cases, cannot recall these events and yet all admit having studied Aristotle's philosophy on the human body and nature. Maybe, this says to us that much of what is learned in science is personal and purposeful to the individual. Thus the science teacher needs to have an ample number of reading activities selected/or designed for the individual. Cooperative learning in reading is important, but so are individual endeavors. The teacher needs to stress group endeavors as well as individual projects and experiences in reading.

Also, adequate emphasis should be place on how to do something in reading. I have noticed and observed pupils making models by following directions. Thus model cars, planes, trucks, among others, are assembled through reading. Here, pupils tend to perceive much purpose or reasons for reading. Teachers need to locate materials for pupils which the latter finds interesting and purposeful. These ingredients assist pupils to become better readers. Exercises in workbooks, textbooks, and project construction contain directions which need to be followed accurately. Wrong responses from pupils can come about if directions are not followed accurately and thoroughly. Pupils need much practice in reading to follow directions. They should be able to state directions read into their very own words so that meaning and understanding are there.

Pupils should develop skills early in the public school years of

becoming research orientated. I believe that scanning information is very important. When I worked on my doctoral dissertation as well as on many term projects, I scanned the table of contents and articles in educational journals and textbooks to see of the content was relevant. The skill of scanning can be learned by pupils at a young age. Many of our pupils will be going on to higher education where this skill becomes important in locating information for term projects and papers developed. In the workplace, workers may also need to scan pages to see where relevant information is located, such as an automobile mechanic scanning pages in a manual to notice how to repair an air-conditioner in an older car.

Closely related to scanning is the reading skill of skimming content. Skimming also is a rather rapid type of reading since not every word is read when a person skims for a few ideas such as names, dates, and places. If a pupil reads to determine the birth and death of Louis Pasteur he/she will look for numerals in skimming an entire page or more. Or, if a learner is looking for Edward Jenner and his inoculation procedures for small pox the name of that person will have capital letters for each name. The capital letters set the name off from other subject matter on the page, except for the beginning of a sentence or the names of cities. Generally, there are very few items that start with capital letters on a page of content. Knowing this assists the individual in doing a better job of skimming. Pertaining to skimming, Ruben (1983) wrote:

> Setting purposes for reading is a crucial factor in reading. Students need to learn that they read for different purposes. If they are reading for pleasure, they may either read quickly or slowly based on the way they feel. If they are studying or reading information that is new to them, they will probably read very slowly. If, however, they are looking up a telephone number, a name, a date or looking over a paragraph for its topic, they will read much more rapidly. Reading rapidly to find or locate information is called <u>skimming</u>. All skimming involves fast reading: however, there are different kinds of skimming. skimming for a number, a date, or name can be done much more rapidly than skimming for the topic of a paragraph or to answer specific

questions. (Some persons call the most rapid reading scanning and the less rapid reading skimming.) Teachers should help pupils recognize that they read rapidly to locate some specific information, but that once they have located what they want, they may read the surrounding information more slowly.

It is quite obvious that there are numerous purposes for reading in science. The purpose involved determines how rapidly one will read or how slowly. The amount of background information possessed as well as the complexity of the materials will also determine the rate at which something is read.

Teachers need to assess reading comprehension of pupils. Barr and Sadow (1985) wrote:

An assessment of reading comprehension serves a twofold purpose. It enables the teacher to make an informed decision regarding the level of materials that would be appropriate for instruction, and it alerts the teacher to a student's specific instructional needs. Such an assessment is generally undertaken when there is some question concerning a student's present placement in instructional materials or the type of instructional emphasis that would enable the student to make better progress. For the most part these questions arise when a student is not performing well during daily lessons. But they should arise also when a student is performing extremely well. For instructional materials should be neither so difficult that the student can have little success with them nor so easy as to require little thought or intentional effort. Thus the student who is always able to answer the teacher's questions may need more challenging materials, while the student who can seldom answer questions correctly may need less demanding ones. Teachers must make every effort to see the instructional materials are optimal from this point of view.

How Should A Reading Assignment Be Introduced?

The science teacher should have several strategies available to guide pupils in reading a new selection. I would recommend first that the teacher try to ascertain which words in the lesson to be read, pupils may have difficulty with. Certainty is not involved here. The teacher, however, should know his/her pupils well enough to do a good job of hypothesizing which words pupils may have trouble identifying unless there is assistance prior to reading. I recommend that these words be

printed on the chalkboard so that all can see them clearly, written in sentences. Have pupils trade off reading an entire sentence with the new word therein. It is best if pupils get as much practice as possible in pronouncing what are perceived, by the teacher, to be new words. Go over the new words within sentences as often as is necessary so that pupils may master these words and identify them when reading science content silently. I would make certain that there is meaning and understanding of these new words as a part of learning to identify each word. Then too, I believe learners need to identify one or more reasons for reading in science. These reasons may be stated in question form and printed on the chalkboard. Thus pupils have a better idea as to what to read for and that being to obtain answers to questions.

After pupils have had a chance to read the selection silently or orally, the teacher may lead a discussion of science content read which may answer each question. The discussion should be relaxed and not hurried. Pupils need to have opportunities to think of possible answers to science questions. Questions raised by pupils other than what was read from the text may also be discussed.

I believe there should be enrichment activities for pupils following the discussion of the story read from the basal. The following are possibilities:

1. learners individually may read library books on the same topic or by the same author. The teacher needs to introduce selected library books to pupils to whet appetites for reading.

2. performing science experiments, dramatizing, pantomiming, model making, and constructing items that relate directly to content read can be good ways to make use of knowledge acquired.

3. rewriting the contents from the library book involving science fiction.

4. explaining the content orally or through reader's theater might well be challenging for a few pupils.

5. writing test items in science to cover the contents in the reading selection can be interesting for selected learners. The test items may be

exchanged among pupils in order to take the test. Pupils should receive feedback on the quality of their writing of each test item.

Selecting Science Textbooks

Teachers are generally involved in a committee to choose basal science textbook series for the oncoming school year. Certainly, each team member needs to have quality standards in mind when making textbook decisions. I have had numerous science teachers say to me that they believe the following criteria assist in making the best choice possible:

1. The text needs to bring in a reasonable number of new concepts on each page or chapter. If too many new words are mentioned per page, the reading task could be overwhelmingly difficult. Should there be too few new words per page, the book may lack challenge for pupils.

2. Pupils should have a chance to read from each series being considered for adoption to assist in determining which text would best meet the needs of learners.

3. The textbook being considered needs to be written in a style and manner which optimalize comprehension of contents.

4. There needs to be a helpful related manual for teacher use in choosing objectives, learning activities, and appraisal procedures. Generally, there are marginal notes which may assist teachers in the task of teaching science.

5. An ample number of illustrations and diagrams should be in evidence in each chapter to guide pupils to understand content more optimally.

6. The size of the type should be appropriate for the pupils who will be reading from the text.

7. There should be an adequate number of headings and subheadings in each selection of reading to orientate the learner to what the ensuing content will be about.

8. An adequate number of study aids for pupils should be in the textbook. Experimentation should be at the heart of teaching science.

9. The textbook should contain an adequate number of summaries and previews for pupils.

10. There should be a table of contents, index, and glossary for pupil use. An index and glossary may not be in a text for young learners.

Participants on the committee to select the science text should invite comments from other teachers who will also be using the adopted textbook. Members of the selection team need to have available for all teachers an adequate number of science series so that decisions can be made on which text should be adopted. Comments made in the selection process should be courteous and clear. Respect for the thinking of others is important. Due consideration should be given each book. Slighting a series is not in the best interests of selecting a truly quality book in teaching science.

Personalized Reading in the Science Curriculum

There are times when pupils should select their very own library books to read that directly relate to the ongoing science unit. Generally, when pupils individually choose what is to be read, they select that which is interesting and on their very own reading level. The text may be too difficult for a few children to read even with quality methods of obtaining pupil readiness for reading a given selection. Thus an answer may be to have pupils individually choose a library book that has similar information as does the basal textbook.

After choosing a book, from among many others, the learner settles down to read the content. The teacher does not intervene unless a pupil cannot decide upon which book to read or gets bogged down on what is being pursued presently. If a pupil cannot decide upon which book to read, the teacher needs to provide assistance. If a pupil gets bogged down on what is read, the teacher needs to determine reasons for doing so. The following could be inherent reasons:

1. the book is too difficult for the pupil to read and understand.
2. the pupil needs to be encouraged to pursue what is difficult to

read.

3. a peer approach may be used whereby two pupils change off reading the contents to each other and assist where there are problems.

4. the contents may be cassette recorded by a good reader and the involved pupil may listen to the contents, following along in his book, as the tape is being played. The learner then may be able to read the book on his/her own.

5. rewards may be given to honor those pupils who read a designated number of library books within an interval of time. Following the completion of the reading of the library book, the learner may share the contents with others during discussion time in the ongoing science unit of study. The learner may also have a conference with the teacher to appraise comprehension and understanding of what had been read. The teacher may also check fluency of oral reading, word attack attack skills, and attitudes toward reading content in science. Ideally, the pupil should share during class discussions what was learned from reading library books. Each library book read relates directly to the ongoing lesson or unit of study in science being pursued.

Experience Charts in Science

Primary grade pupils, in particular, like to develop experience charts with teacher guidance. Although when pupils can do their very own writing, they should do so. As the name indicates, an experience chart relates directly to what pupils have experienced in science. For example, a first grade teacher may have the following objects on an interest center to initiate a unit:

1. a model self-propelled combine and a tractor. Here, pupils may study simple machines, involved in physics, inherent in the combine and tractor.

2. model farm implements for the tractor to pull. A further study of simple machines involved in performing work may be stressed.

3. a model farm truck to haul grain. An overview of how gasoline

powered engines operate may be emphasized.

4. samples of corn, wheat, and oats. Tests on germination may be made.

5. a model set of farm animals. Here, learners may study automation in feeding farm animals.

Pupils may study the models on the learning center and ask questions of each other and of the teacher. Perhaps, questions such as the following are raised by pupils after viewing the models:

1. how does a self propelled combine work to cut grain?
2. how is soil prepared for drilling and seeding grain?
3. what determines which grain to seed in a given field?
4. how is automation used to feed farm animals?
5. how is grain stored on the farm?

The above questions, as an example, provide a basis for pupils with teacher guidance to develop an experience chart. Ideas come from pupils pertaining to what was experienced from the learning center. The teacher assists and guides pupils to present content for the experience chart. The teacher prints the ideas from pupils in neat manuscript letters on the chalkboard or on a transparency for overhead use. I have observed numerous teachers type the ideas presented by pupils using a word processor and a large screen to project the resulting ideas. Learners may then see their talk written down. From the concrete experiences of objects at the learning center, pupils may see the abstract words on the large screen.

After the content has been printed/typed, pupils with teacher help may read the content together orally. The teacher needs to point to the words and phrases as they are being read. This guides pupils into becoming better readers. For some, these are beginning experiences in reading on the early primary grade levels. With the typed/printed subject matter in a transparency or in the computer, pupils may enjoy reading the same content at a later time. Rereading content is good for pupils and provides increased opportunities to develop a good stock of sight

words in science. If the ideas from pupils have been printed on the chalkboard, they may be transferred to a flip chart so the content is saved and can be read later in a loosely bound volume. Sometimes pupil's ideas are printed immediately onto the flip chart. This saves the time of the teacher if this is done; however, many teachers feel they cannot immediately print the ideas correctly from pupils as they are given.

There are numerous questions that arise pertaining to the use of experience charts. Should the teacher write the ideas down directly as given orally by learners. The content may lack completeness, correct grammar, and usage. I would say that the teacher can ask for other ways to state a sentence if the one given has its many weaknesses. A short period of time for brainstorming might well provide the quality of sentences desired by the teacher of science The experience chart may be written individually, within a cooperative learning endeavor, or the class as a whole. There are times when individual pupils have content they desire the teacher write for them. At other times the teacher may wish committee work on an experience chart so there are more chances for learner interaction within a small group. If the class size is large, the teacher may wish to have a smaller group work on an experience chart. The ideas presented by each pupil should be respected by all involved in developing the experience chart (Ediger, 1997, 162-190).

Closely related to experience charts approaches in science reading is the whole language program of reading instruction. Instead of segmenting reading instruction in terms of phonics instruction and other word recognition procedures, whole language advocates advocate the wholeness of content read. It is the entire story or event that is salient. Ediger (1997) wrote the following pertaining to whole language philosophies of teaching and learning in reading:

Teachers, whom I supervise, advocating a strong whole language approach in teaching reading stress the following:

1. reading involves wholeness in that ideas are read sequentially by learners.
2. the wholeness involved in reading should not be interrupted

with phonics or other word recognition techniques. Obtaining ideas, not phonics, is salient.

3. interest in reading generates motivation to learn; interest overcomes problems in word recognition. Much reading then assists pupils to identify an increased number of words.

4. providing assistance to pupils, as needed, is sufficient for learners to recognize unknown words. This, as needed approach, also prevents pupils from fragmenting content read in reading.

5. learner enjoyment in reading needs to be whole, not segmented into parts.

Toward the other end of the continuum, student teachers and regular teachers whom I supervised believed that whole language approaches are more suited toward pupils who can read well, such as in recreational reading. These readers can sequence their very own reading materials at a personal, optimal rate of speed. Little assistance is then needed in identifying unknown words. Teachers, here, agree that selected pupils do use context clues heavily to identify unknown words. Since pupils are different one from another, it stands to reason that some pupils will be orientated toward the whole language approach...

Helping the Mainstreamed Pupil

The Education for All Handicapped Pupils law (PL 94-142) emphasizes that handicapped pupils be placed in the test restricted environment. Too frequently, all handicapped pupils had been placed in a special education classroom. Presently, many of these handicapped pupils are placed into the regular classroom. Here, the regular teacher teaches the handicapped together with normal children in a mainstreamed class. An IEP (individualized educational plan) is written for each pupils who is mainstreamed. The plan spells out with measurable stated objectives what a pupil is to achieve within a given interval of time. Learning activities are indicated for teachers so that they may assist pupils to achieve the IEP objectives. Auditing is possible to determine if objectives have been achieved by the mainstreamed pupil. I have served as an auditor to audit if a pupil has/has not achieved selected objectives. The auditor needs to notice if there is evidence to show that a pupil was successful in goal attainment.

IDEA (Individuals with Disabilities Education Act) was passed by the United States congress and signed by the president in 1990. This law further protects the rights of handicapped pupils with a free and appropriate education. Appropriate means that the pupil needs proper placement and assistance for those who are impaired in speech, hearing, and sight. Orthopedically handicapped pupils also need adequate provisions made for them as do pupils with learning disabilities. Parental involvement, including placement of the disabled, was also emphasized in IDEA.

In research on mainstreaming or inclusion of the handicapped into the regular classroom, Gottlieb and Leyser (1996) wrote:

> The present findings revealed two primary findings. First, that parents who indicated that they had a family member with disabilities were more positive of mainstreaming in 1991 than in 1981, and second that the more positive shift in attitude was not evident for the numerically larger group of parents indicated they did not have a family member with disabilities.
>
> From the perspective of families that had a member with disabilities, the data suggest that the relative commonplace fact of mainstreaming, and inclusion, has reduced concerns and fears of the unknown regarding what might happen in integrated classrooms serving students with disabilities alongside their nondisabled peers. For this community of families, mainstreaming seems now a more acceptable, programmatic option for all children. The magnitude of the change may be indicated as follows: for parents indicating that they have a family member with disabilities, the power of the differences in mean attitude scores between 1981 and 1991 was 1:00, with an effect size of 3:00. This represents a powerful difference in attitude scores.
>
> Parents who did not report the presence of a family member with disabilities did not express a shift in attitudes, either in the positive or negative direction. Evidently, mainstreaming did not arouse parental concerns that their nondisabled children would be negatively affected by the presence of classmates with disabilities...

The IEP protects handicapped pupils so they are not ignored in teaching and learning. There are goals that need to be achieved by these learners. The IEP's also spell out what kinds of services are to be received by each handicapped child such as speech correction for the

impaired child in speaking. Teachers, the principal, and parents need to be involved in developing the IEP as well as identifying the necessary services to be provided.

The teacher of science then needs to provide for the handicapped pupil who is mainstreamed into the regular classroom.
The IEP objectives need to be met in teaching. Hopefully an aide will assist the regular teacher to provide for the mainstreamed handicapped pupil. There are no easy ways of teaching any pupil, be it mainstreamed or normal pupils. I, however, recommend the following in teaching the handicapped:

1. Determine where each pupil is achieving presently and then, based on these findings, develop an IEP. Involve teachers, the principal, parents, and the guidance counselor in developing an appropriate IEP.

2. Provide all needed services for the handicapped, such as speech correction and ways to remedy learning disorders such as dyslexia.

3. Use learning opportunities that stimulate and encourage pupils to achieve objectives.

4. Evaluate to notice learner progress in achieving objectives.

5. Use evaluation information to improve the quality of teaching the handicapped.

6. Make certain aides have been properly instructed as to their roles in teaching handicapped pupils.

7. Discuss with parents which is better for their child, mainstreaming or being taught in a special education class.

Slow learners, in general, may be guided through a variety of learning opportunities in achieving more optimally. A good reader or the teacher may read orally to these pupils as they follow along in their own science textbooks. The content read orally might then be discussed with the slow learner. These same pupils should receive practice reading the same content that was read orally. The background information as well

as seeing and hearing the words pronounced accurately provides the kinds of knowledge and skills needed to read on their own.

If there is teacher time, simplified content will assist the slow learner to do a better job of reading. Subject matter can always be simplified by using easier terms in context as well as sentences that are more readily understood. I have found that pupils who lack reading skills appropriate for what others are reading may select and read related library book content in science. There should be an atmosphere of respect when provisions are made for individual differences. When I was an elementary teacher, a student of mine complained why she had to do more work than another pupil who lacked needed knowledge and skills. I remarked to her that it is truly a gift and a privilege to do extra work. There are so many people not able to work and achieve, is it not a blessing to be able to do more than others who are unable to do so, for various reasons? I believe most children in school want to learn much and achieve at a high level, as much as abilities permit. I believe there is an inward feeling of satisfaction with high achievement. An inadequate self concept says, "I can't do this." Or, "It is impossible for me to learn as much as others do." The self concept needs to be nurtured and supported of each pupil. Learners need to achieve success through hard work and feel they can be successful. I have found, numerous times, that there are pupils who do not learn as much as they are capable of. This hurts the self concept of the pupil. The learner is not achieving and can do better, regardless of ability levels. There is joy in achieving and learning , be it utilitarian to be used in a practical situation or in having worth for its own sake. Learning activities should be there to assist pupils to learn as much as possible on an individual basis.

In addition to reading orally as well as simplifying content for pupils in reading, the teacher also may use the experience chart idea whereby, from an experience, pupils may present the subject matter orally for the teacher to record on a chart. Pupils then see talk written down and may then read it back to the teacher orally. This procedure is

very sound. Pupils are reading their very own ideas; they have the necessary background information from personal experiences such as an excursion on the schoolgrounds to notice sheet or gully erosion. These learners also know and can identify words in reading since the words came from involved pupils. By saving the experience charts, pupils may read again and again, if they wish, the printed content.

The Reading Recovery Program, brought to the United States from New Zealand, is a one on one program of instruction. One teacher for one child can make much difference on achievement in science. Here, I recommend securing volunteers from the community to guide slow learners in reading science content. One teacher for one child should ensure for success in reading. The aide may then assist pupils in word recognition as well as read science content to the child orally. There are ways of teaching whereby all pupils may be successful in learning. With the many audio-visual materials of instruction available, where no reading is required, pupils can learn many salient concepts and generalizations in science in ongoing lessons and units of study.

Assisting the Gifted

The gifted and talented, too frequently, are left out of the spectrum in providing for individual differences. These learners also need their fair share of time with the classroom teacher. They need quality, challenging objectives, learning opportunities which truly emphasize reaching for the stars, as well as valid and reliable evaluation techniques. What might the science teacher do to assist each pupil to learn as much as possible? I would recommend individual and cooperative projects that stimulate and encourage the gifted/talented to lofty, attainable goals. A research project might then be stressed that relates to, but goes beyond regular classroom work. The research project should have a clearly stated problem. The problem is important and relevant. A variety of reference sources and activities should be used to gather information directly related to the identified problem. Pupils are clear on the reference sources to be used. The teacher needs

to provide direction on available references and the use of each. The internet, along with other sources, may provide necessary information in answer to the problem. A tentative answer may then be developed. The answer here is tentative since it needs to be tested in a utilitarian way. Additional resources may be used in the testing of the answer. This may mean revising the answer, if evidence warrants. Integration of content is a key concept in using problem solving as a means of teaching and learning. Pertaining to an integrated curriculum, Harp and Brewer (1991) wrote:

A scope and sequence decision that will profoundly alter the way you teach is whether you will integrate the curriculum, by which we mean combining instructional objectives from two or more curriculum areas into one lesson or unit. We believe that teachers face an impossible task when they view each piece of the curriculum as a single building block and teaching as stacking those blocks one on to the other.There are too many curriculum blocks to build a tower successfully. In making scope and sequence decisions you need to search for ways to integrate the curriculum. Obviously, we believe that reading and writing should be taught together. Other possible combinations are music and reading, reading and art, social studies and writing and reading, and science and physical education.

I concur that reading and writing in a research project are one, not separate entities. Certainly there is much reading that gifted/talented pupils need to do as well as considerable writing in conducting research in the science curriculum.

Newsmagazines and daily newspapers from the centralized library may provide further information sources for the gifted/talented. Pupils may read and discuss current events items in science within a cooperative learning endeavor. The teacher needs to be on the lookout for learning activities to optimalize learning for the gifted/talented. Ediger (1984) wrote:

A quality teacher is a proficient evaluator of learner progress. A variety of appraisal procedures need to be utilized. Among other evaluation techniques, the following may be utilized:

1. Teacher observation.
2. Anecdotal records.
3. Sociometric devices.

4. Teacher written tests.
5. Checklists and rating scales.
6. Standardized achievement tests.
7. Personality tests.
8. Interest inventories.
9. Criterion referenced tests.
10. Self-evaluation by the learner.

In Summary

There are numerous means available to guide pupils to achieve more optimally in reading in science. The teacher should assist pupils in word recognition in context. This is a powerful way to have learners recognize unknown words. At the same time, recognizing words in context does not hinder in securing sequential ideas while reading. Reading science content then needs to be as holistic as possible. However, teachers must be available at teachable moments whereby analyzing words may be highly beneficial to pupils. Thus a small amount of time, as needed, may be given by the teacher to guide learners in phonics or syllabication. By giving time in analyzing unknown words, the teacher is helping pupils to develop a wider array of sight words. Reading fluently and in a manner stressing diverse approaches in comprehension is an ultimate goal in reading in science. Basal texts may be wisely used a a part of the science curriculum, but this does not, by any means, stress the entire unit of study. It is one learning activity among many others. Learners need to use content from science textbooks to identify and solve problems. The basal textbooks might also be used to check hypotheses and in their revision.
If textbooks have a quality manual section, this aids the teacher in selecting objectives, learning opportunities, and evaluation techniques. Suggestions for improving teaching should always be welcomed by the teacher (Ediger, 1998, 14-17).

Basal science textbooks may be used to guide pupils in securing needed facts, concepts, and generalizations within the framework of problem solving. Higher levels of cognition should be stressed in the science curriculum. Certainly, a good teacher is not satisfied with

pupils achieving facts only or largely, but has pupils move in the direction of thinking critically and creatively about content being pursued. Individual differences need to be provided for in reading content in science. Ediger (1997) wrote the following for a quality program of reading instruction in the science curriculum:

1. Each pupil begins at a point where he/she is ready to achieve as optimally as possible.
2. The learner experiences continual progress successfully in reading.
3. The four vocabularies- listening, speaking, reading. and writing- are integrated into a quality reading program.
4. Word recognition skills, such as phonics, syllabication, context clues, and structural analysis, are taught within a framework of interesting content to be read.
5. Major emphasis placed upon reading literature, not analyzing words into component parts.
6. Multimedia approaches are used to motivate pupils so that an inward desire in learning to read is inherent.
7. Problem solving, critical and creative thinking, as well as application of salient concepts stressed in teaching reading.
8. The best sequence is used to guide each pupil toward optimum achievement in reading.
9. Learning to read as a lifetime endeavor is stressed.
10. The use of relevant research results is important in the teaching of reading.

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